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Solans et al.

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(54) **TARGET FOR A PRINTING AND CUTTING PROCESS**

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B41J 11/66 (2006.01)

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CPC ***B41J 11/663*** (2013.01); ***B41J 11/70*** (2013.01)

(58) **Field of Classification Search**
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See application file for complete search history.

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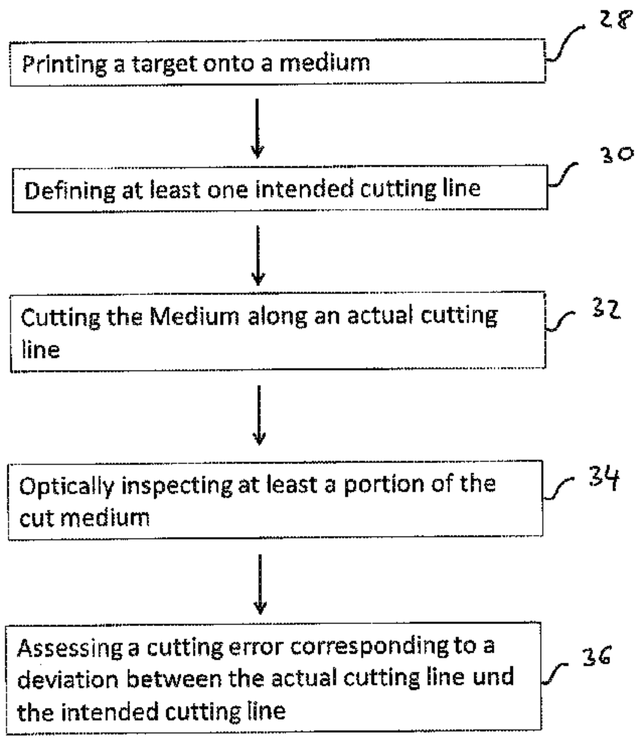
(57) **ABSTRACT**

A method is provided. The method includes printing a target on a medium and defining at least one intended cutting line on the medium. The target includes at least one graphical element which defines at least one reference distance measure. The target is centered at the intended cutting line or has a defined distance to the intended cutting line.

15 Claims, 7 Drawing Sheets



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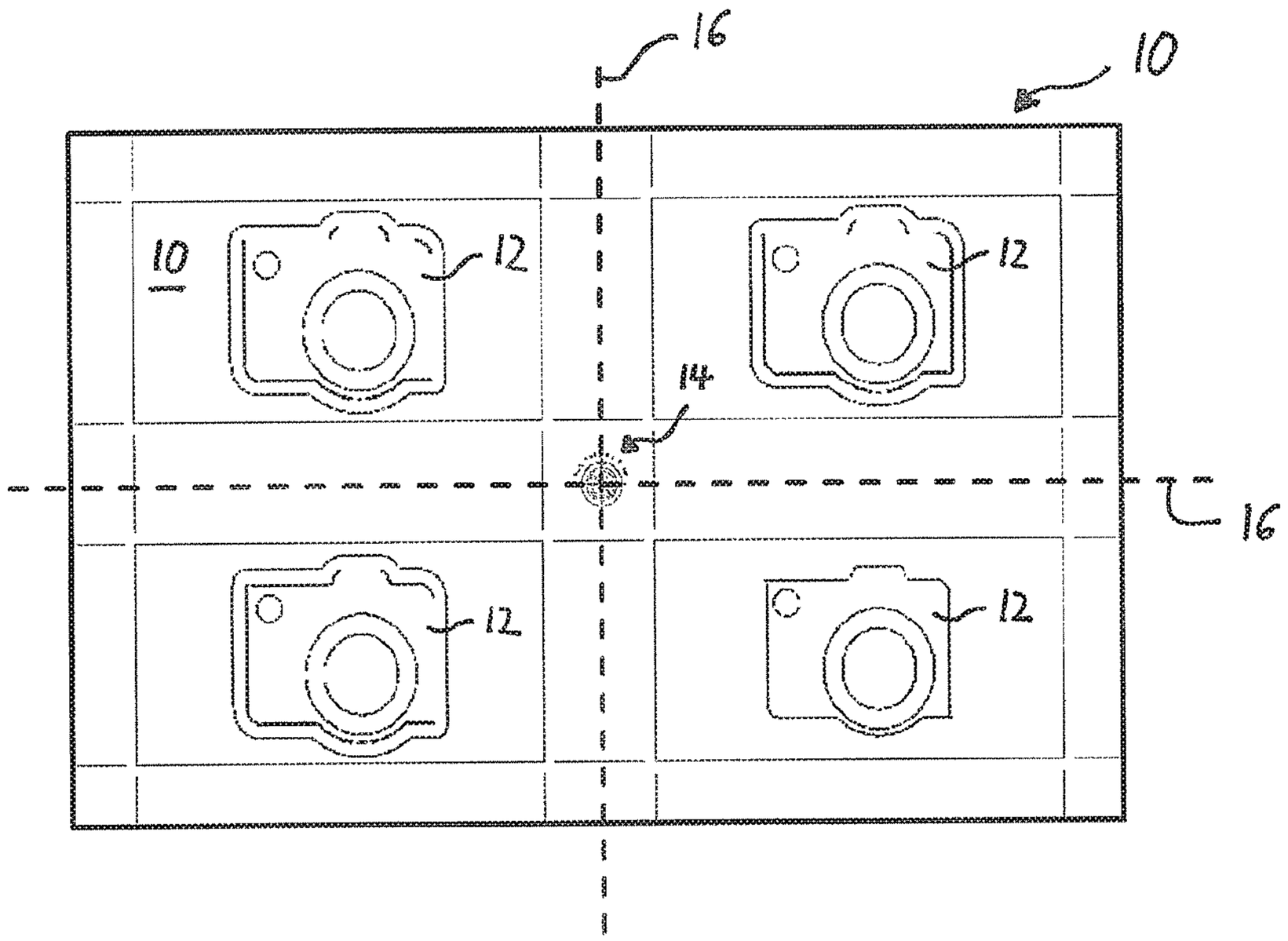


Fig. 1

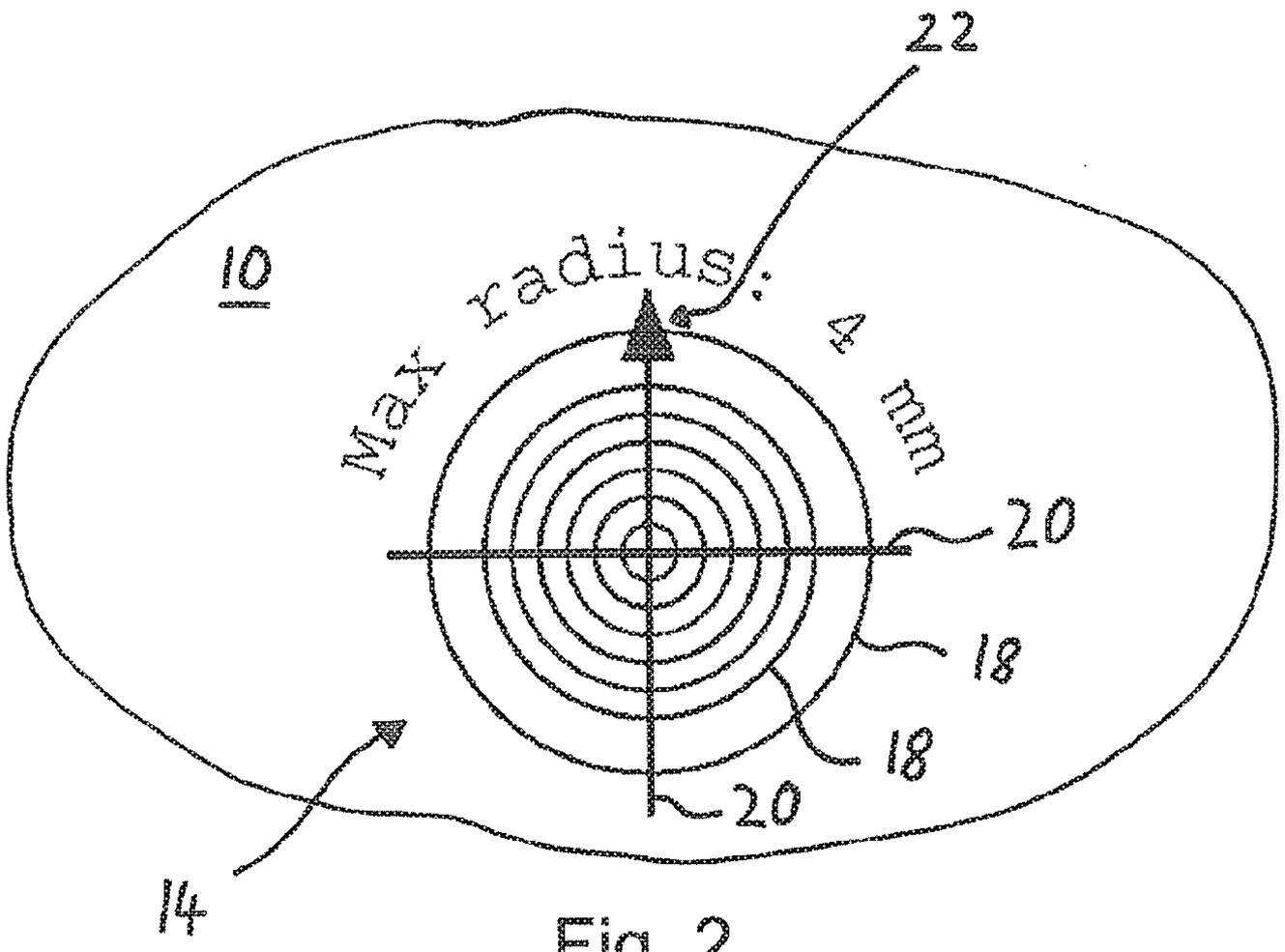


Fig. 2

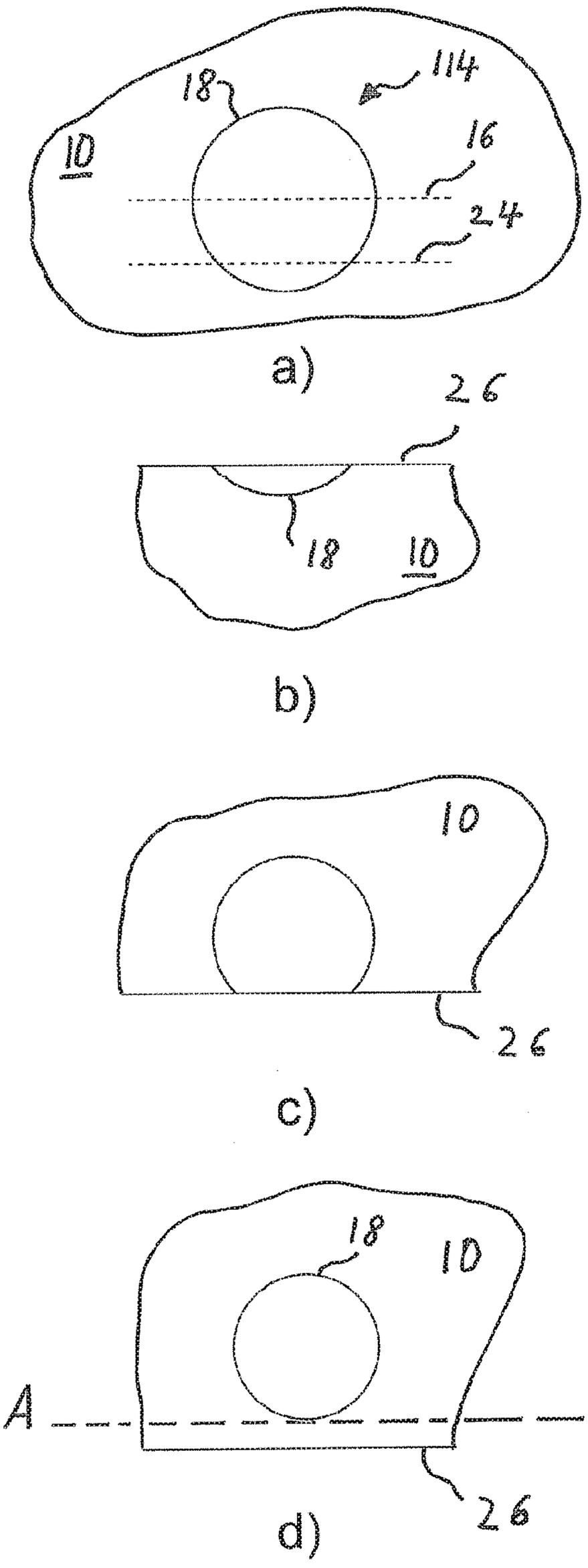


Fig. 3

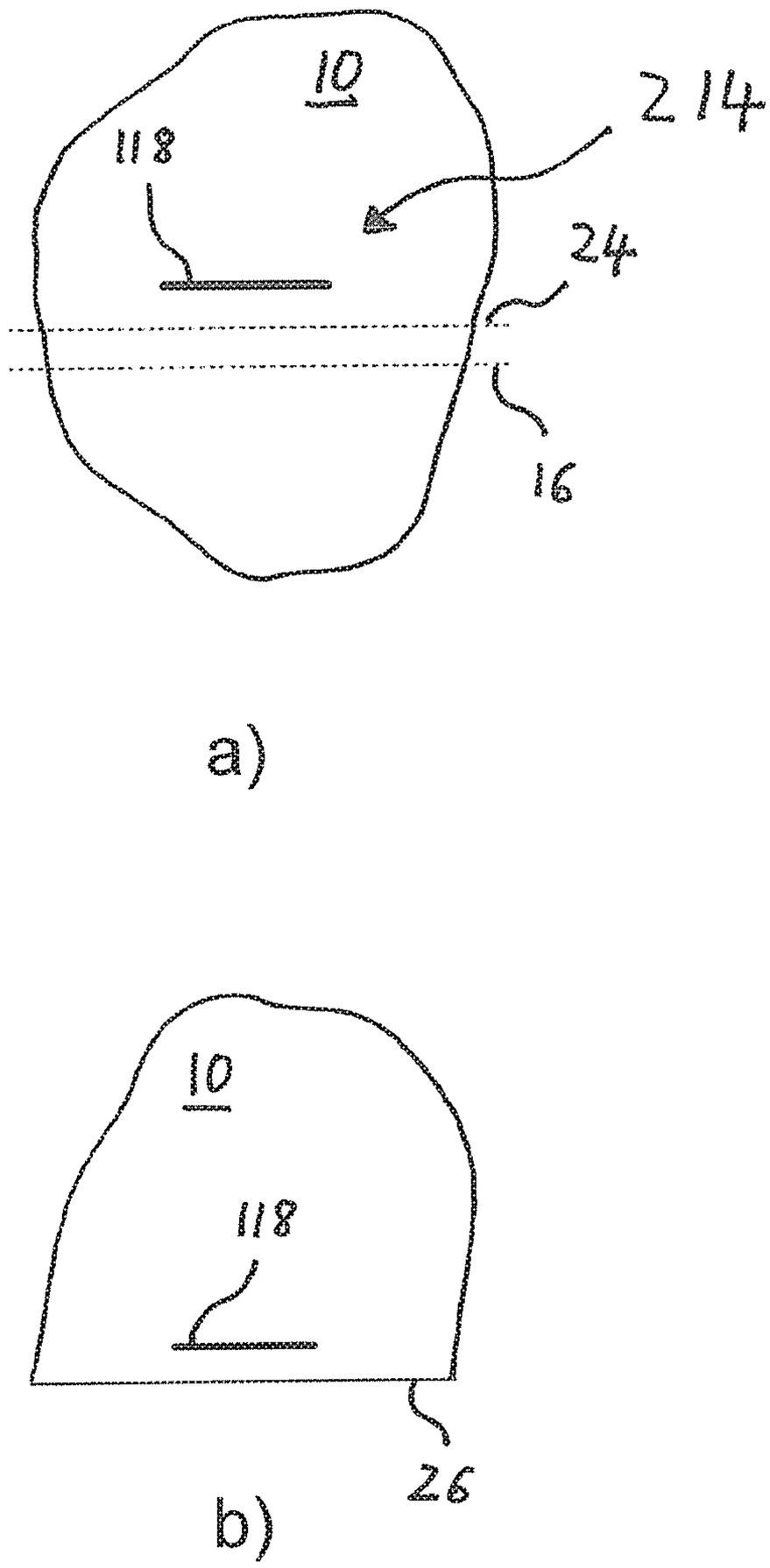
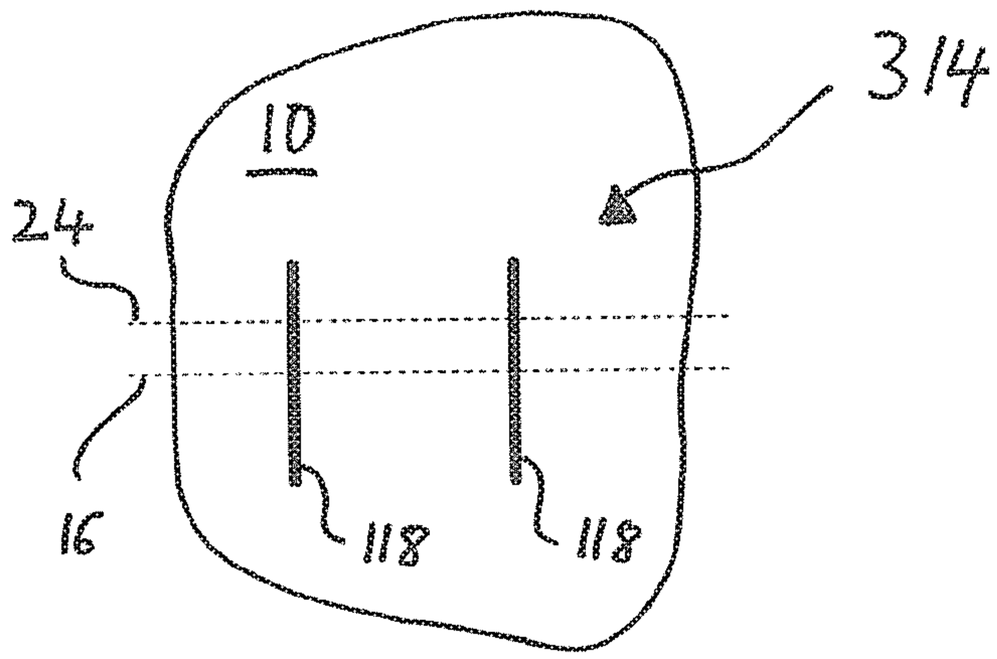
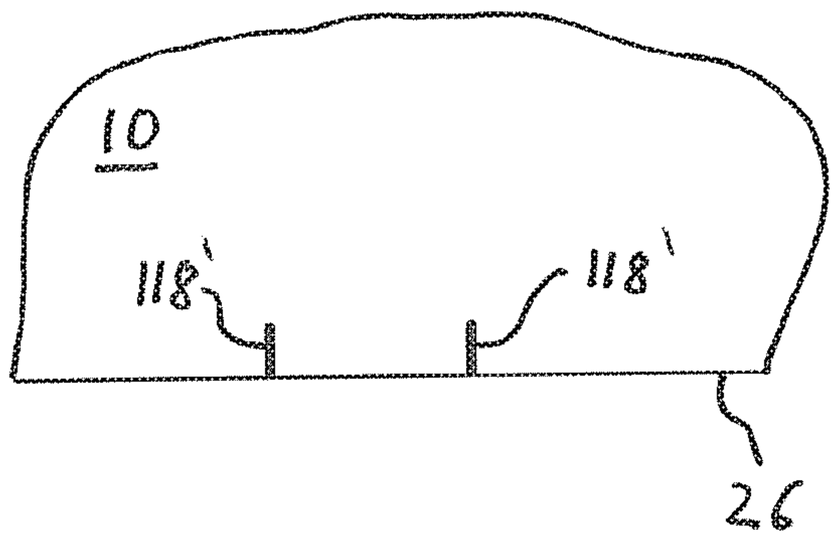


Fig. 4

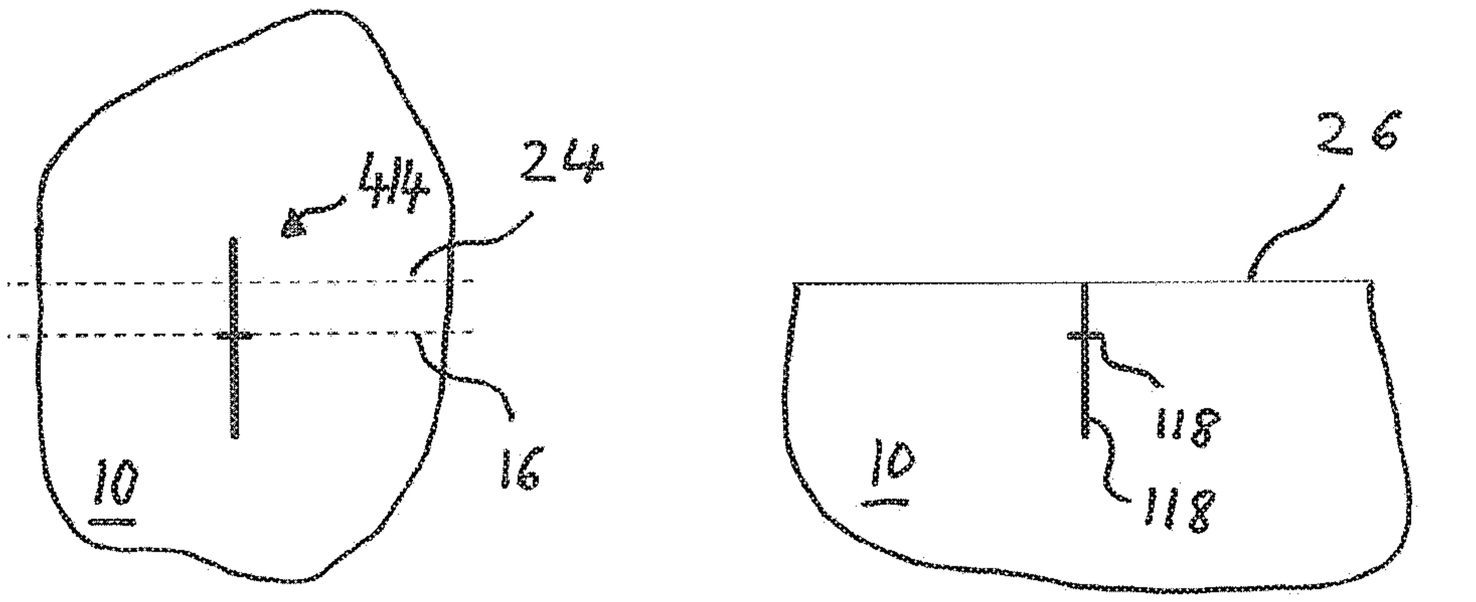


a)



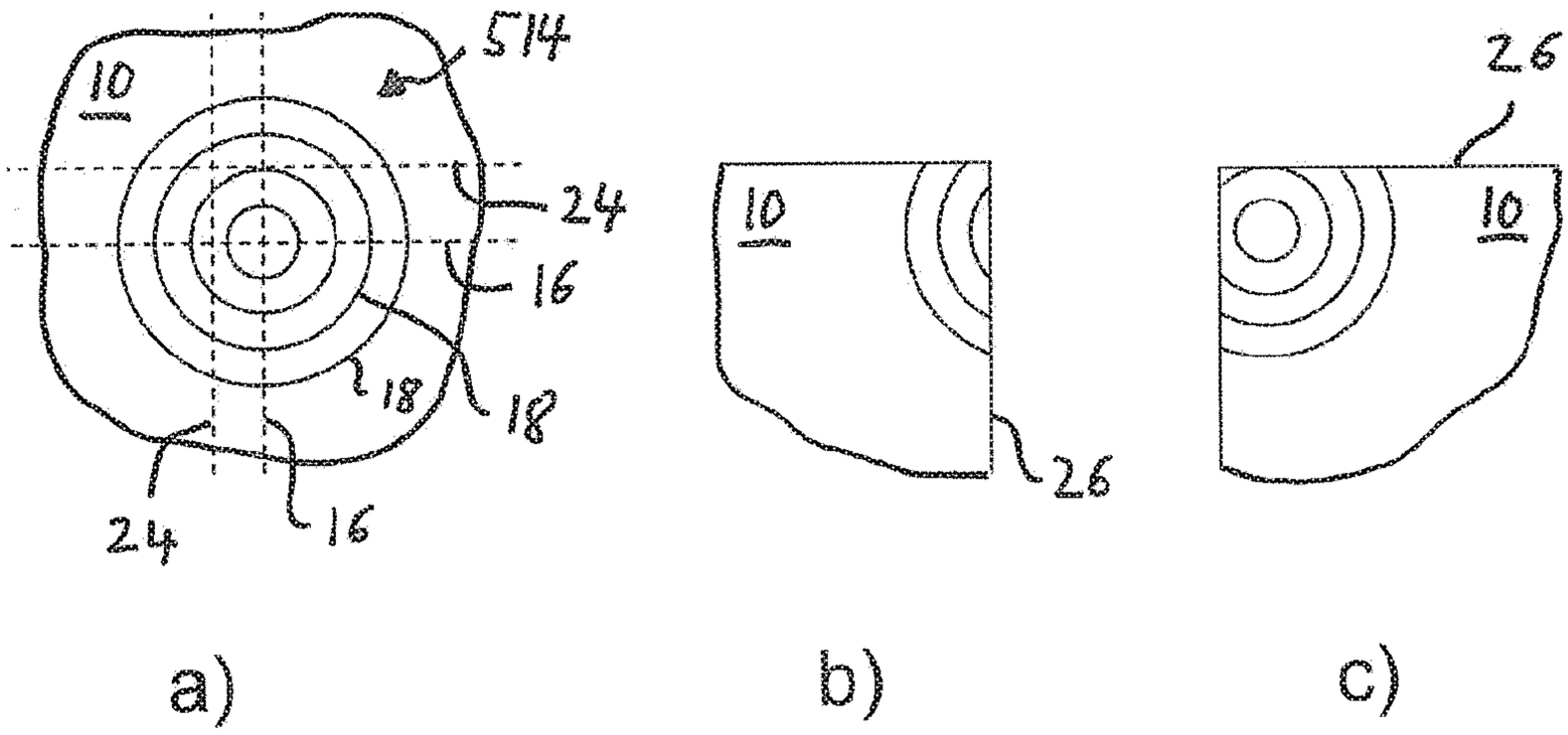
b)

Fig. 5



a) b)

Fig. 6



a) b) c)

Fig. 7

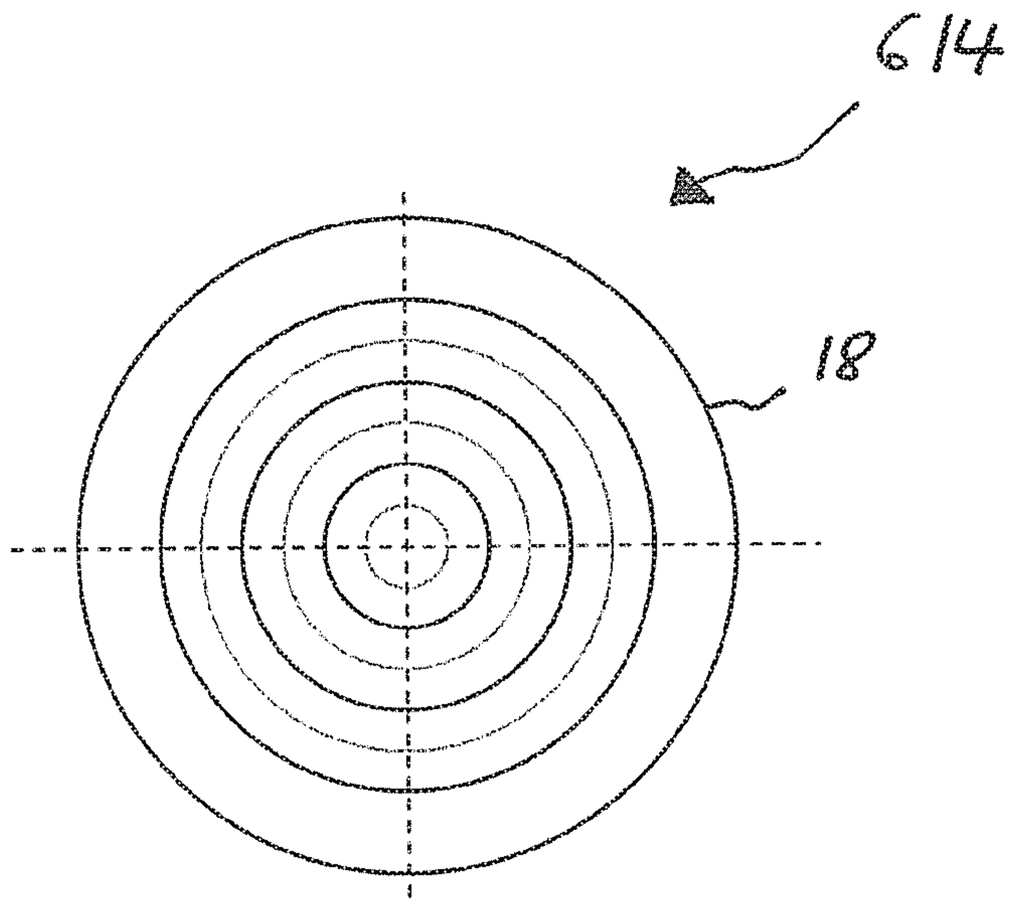


Fig. 8

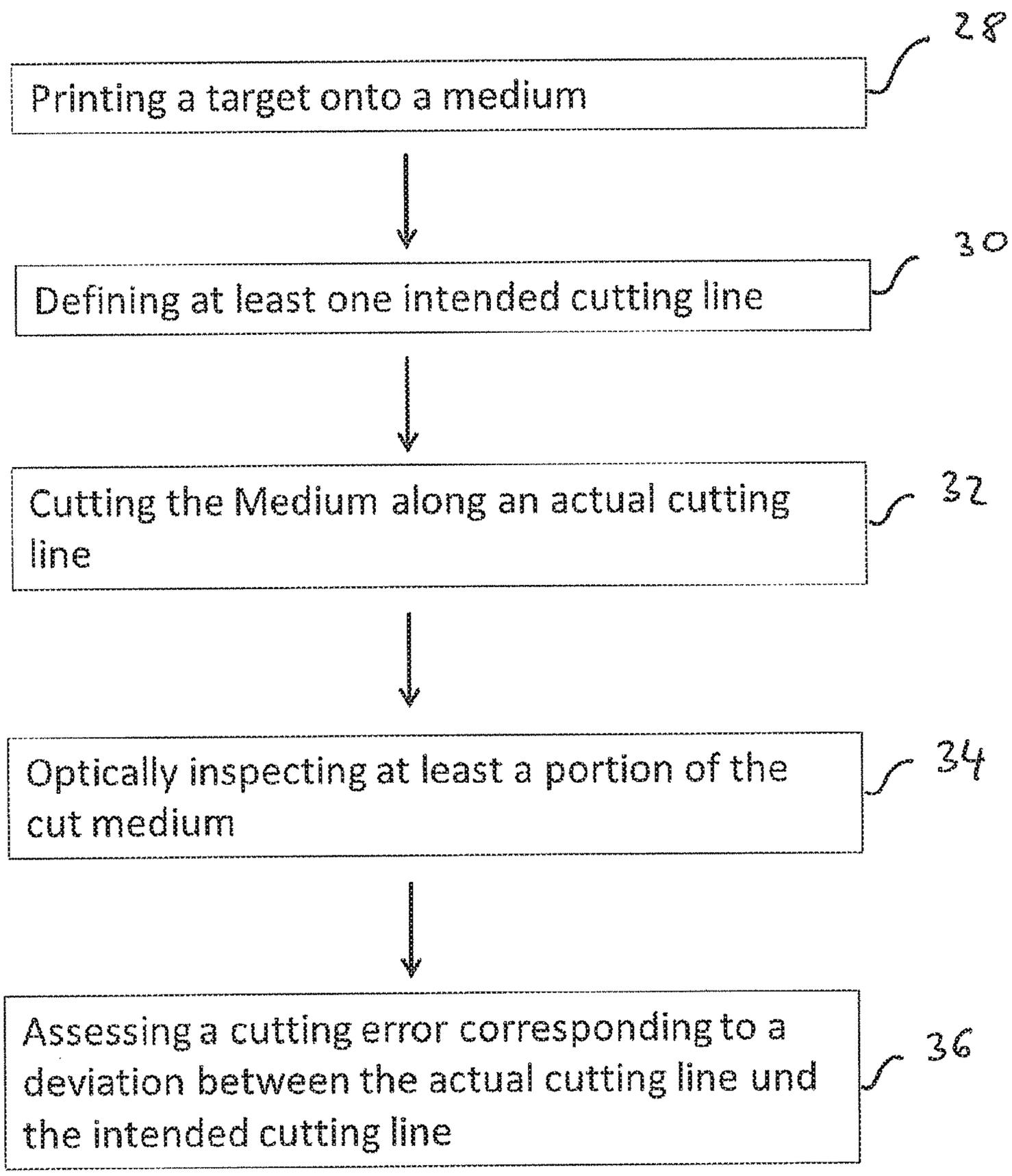

Printing a target onto a medium
28
Defining at least one intended cutting line
30
Cutting the Medium along an actual cutting line
32
Optically inspecting at least a portion of the cut medium
34
Assessing a cutting error corresponding to a deviation between the actual cutting line und the intended cutting line
36

Fig. 9

TARGET FOR A PRINTING AND CUTTING PROCESS

BACKGROUND

In printing and cutting processes graphical objects, also referred to as artwork, are printed on a medium. Later, the medium is cut along cutting lines, which are also referred to as trim lines or crop marks, or along contour cutting paths. The medium may be a sheet of paper or a foil, for example.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a media sheet with a printed target thereon which may be used according to an aspect of the present disclosure.

FIG. **2** shows the target of FIG. **1** which may be used according to an aspect of the present disclosure.

FIG. **3** shows another example of a target which may be used according to an aspect of the present disclosure.

FIG. **4** shows a further target which may be used according to an aspect of the present disclosure.

FIG. **5** shows a similar target as illustrated in FIG. **4** which may be used according to an aspect of the present disclosure.

FIG. **6** shows a further target which may be used according to an aspect of the present disclosure.

FIG. **7** shows a further target which may be used according to an aspect of the present disclosure.

FIG. **8** shows a further target which may be used according to an aspect of the present disclosure.

FIG. **9** shows a sequence of a process according to an aspect of the present disclosure.

DETAILED DESCRIPTION

When cutting printed objects from a media sheet, for example using a contour cutter, there is the risk that the medium was uniformly or non-uniformly distorted during the printing process or afterwards. Further, the printing process may have been misaligned with respect to the media sheet. As a result, the cutting tool may not pass, at sufficient accuracy, along the intended cutting line which may have been defined by the graphic designer together with the printed artwork, for example. Cutting errors may be visible, e.g. as white areas along the cutting line, if the error exceeds the amount of bleeding, i.e. the amount by which the printed object extends beyond the intended cutting line. For assessing the accuracy of the cutting process with respect to the printed object on the media sheet, different parts of the cut media may be inspected after printing and may be analyzed, e.g. for white edges.

FIG. **1** is a plan view of a media sheet **10** which may be used in a printing and cutting process according to an aspect of the present disclosure. On the media sheet **10**, plural graphical objects **12** are printed in combination with a target **14**. The media sheet **10** may be a sheet of paper, cardboard, textile, plastic plate or foil, for example. FIG. **1** further shows a first intended cutting line **16** along the length direction of the media sheet **10** and a second intended cutting line **16** along the transverse direction of the media sheet **10**.

The intended cutting lines **16** may define respective paths relative to the graphical objects **12** along which the media sheet is to be cut after the graphical objects have been printed.

The paths of the intended cutting lines **16** can be defined with respect to the graphical objects **12** before the printing process by the graphics designer. In some examples, the

intended cutting lines **16** are printed on the media sheet **10** together with at least one graphical object **12**. In other examples, the intended cutting lines **16** are not printed and do not appear on the medium but correspond to the information of their paths, i.e. orientation, direction and position, relative to the graphical objects **12** and/or relative to the medium **10**. The information of an intended cutting line **16** can be used by a cutting device for cutting the media sheet. In some examples, the cutting device may be part of a combined printing and cutting system. In other examples, the cutting device may be dedicated for cutting only.

FIG. **2** is an enlarged view of the target **14** of FIG. **1** which is printed on the media sheet **10**. In the example of FIG. **2**, the target **14** comprises plural graphical elements corresponding to a number of concentric circles **18** having different radii. When the target includes multiple concentric circles, the distance between the circles may vary. For example, the outer circles can have larger distances and the inner circles can have smaller distances. The distances from the outer circle to the inner circle can decrease from 2 mm to 0.5 mm or from 1 mm to 0.5 mm, for example. Further, there may be a larger number of "inner" circles having a smaller distance than outer circles having a larger distance. In the example shown in FIG. **2**, the target comprising seven concentric circles, with the radius of the outer circle being 2 mm, the radius of the second outer circle being 3 mm, and the radius of the further inner circles decreasing in steps of 0.5 mm. In this example, the smallest inner circle hence has a radius of 0.5 mm, and the distance between the six inner circles is 0.5 mm between respective two neighboring circles.

Different circle sizes, different numbers of circles and different distances between circles may be chosen. Further, targets having graphical elements of different shapes may be designed.

The target **14** of FIG. **2** also comprises an indication of a value of a reference distance measure of the target **14**, namely the indication "max radius: 4 mm". Each radius of the circles **18** may represent a respective reference distance measure of the printed target **14**. In the example of FIG. **2**, each reference distance measure of the printed target **14** is defined and visualized by a corresponding circle **18** the reference distance measure(s) may be used for assessing cutting accuracy, as will be explained further below.

Additionally, the printed target **14** of FIG. **2** comprises two lines **20** and a mark **22**. The mark **22** may indicate the orientation of the target **14** relative to the arrangement of the graphical objects **12**, relative to the intended cutting lines **16** and/or relative to the media sheet **10**. The function of the mark **22** will be explained in more detail further below.

When the target **14** is printed on a media sheet **10**, the lines **20** may be aligned with corresponding intended cutting lines **16**. In other words, the lines **20** may be an exact graphical representation of the intended cutting lines **16**. In this case, the lines **20** visualize the paths of the intended cutting lines **16** or portions thereof, where the medium is to be cut relative to the graphical objects **12** and/or boundaries of the medium **10**.

Referring to FIG. **3***a* to **3***d*, which show another example of a target **114**, the use of the target **114** according an aspect of the present disclosure is explained. The target **114** of FIG. **3***a* comprises only one graphical element, namely a circle **18**, which is printed on a medium **10** and which is centered with respect to an intended cutting line **16**. The radius of the circle **18** corresponds to a reference distance measure of the target **114**. In the present disclosure, a reference distance measure corresponds to an actual distance on a medium and

can be assigned to a target. If targets are printed at different sizes, the reference distance measures of the printed targets will be different. For example, the reference distance measure of the printed target **114** of FIG. **3***a*, e.g. the radius of the circle **18**, may be 1 mm. In other examples, the target **114** can be printed at other sizes and therefore can provide other reference distance measures, e.g. within the range of 0.5 mm to 4 mm, as explained with reference to FIG. **2**.

When the medium **10**, on which the target **114** is printed and for which the intended cutting line **16** has been defined, is cut, the actual cutting line **24** may deviate from the intended cutting line **16** as shown in FIG. **3***a*. This deviation might be caused, for example, by a misalignment between the printing process and the cutting process and/or by a distortion of the medium **10**. Cutting along the actual cutting line **24** in FIG. **3***a* cuts the medium **10** into two parts. Portions of the parts are shown in FIG. **3***b* (lower part of FIG. **3***a*) and FIG. **3***c* (upper part of FIG. **3***a*).

Both of the parts shown in FIGS. **3***b* and **3***c* may be used to assess the accuracy by which the medium **10** has been cut with respect to the intended cutting line **16**. From the part shown in FIG. **3***b*, it can be recognized that the remaining portion of the circle **18** and the cutting edge **26** form a circle section being less than half a circle. This means that the cutting edge **26**, which coincides with the actual cutting line **24**, has a distance to center of the circle **18** which is larger than zero and smaller than the reference distance measure corresponding to the radius of the circle **18**. Accordingly, if the center of the printed circle **18** is defined to coincide with the intended cutting line **16**, it can be recognized from the part of FIG. **3***b* that the cutting error is larger than zero and smaller than the reference distance measure. A similar assessment leading to the same result is possible by inspecting the complementary part of FIG. **3***c*, which shows a remaining portion of the printed circle **18** which is less than a full circle but more than half a circle. This allows for the qualitative and quantitative determination that the cutting error is smaller than the reference distance measure and larger than zero.

In the example of FIG. **3***d* a part of a medium, with the target **114** printed thereon, is shown which would result from a cutting process along another actual cutting line different from the actual cutting line **24** shown in FIG. **3***a*. If the result of the cutting process is as shown in FIG. **3***d*, and if the target **114** was centered with respect to an intended cutting line **16**, it can be determined from the part shown in FIG. **3***d* that the cutting error is larger than the reference distance measure, because the actual cutting line does not intersect the circle **18**. From the part of FIG. **3***d* it can be recognized that the cutting error is about 1.5 reference distance measures, assuming that the intended cutting line **16** intersects the center of the circle **18**. If, for example, the reference distance measure is chosen to be 0.5 mm, it can be concluded that the cutting error is in a range between 0.5 mm and 1 mm and is about 0.75 mm.

It is not mandatory that the target **114** is centered with respect to the intended cutting line **16**. In other examples, the target **114** may have a defined distance from the intended cutting line **16**, wherein this distance can be taken into account when inspecting a part of cut medium containing at least a part of the printed target **114** for assessing the cutting accuracy. For example, the target can have a defined position relative to the intended cutting line, which is offset from the intended cutting line in a direction transverse to the path of the intended cutting line. For example, for the printing and cutting process which is assessed by inspecting the part of FIG. **3***d*, the intended cutting line may have been defined to coincide with a line A, which is a tangent to the circle **18**, as shown in FIG. **3***d*. In this case, it can be recognized from inspecting the part of FIG. **3***d*, that the cutting error is less than the reference distance measure of target **114** and corresponds to about half the reference distance measure, because the distance of the tangent line A (and the circumference of the circle **18**) from the cutting edge **26** corresponds to about half the radius of circle **18**, in FIG. **3***d*.

In FIG. **4**, another example **214** of a target is shown, which allows for an assessment of a cutting accuracy according to an aspect of the present disclosure. FIG. **4***a* shows a part of a medium **10** carrying a printed target **214** thereon which, in this example, comprises just one graphical element, namely a straight line segment **118**. In this example, the length of the printed line segment **118** corresponds to the reference distance measure of the target **214**. The straight line segment **118** of the target **214** has a predetermined distance from a corresponding intended cutting line **16**. This distance is used when assessing the cutting accuracy. In the example of FIG. **4**, the predetermined distance of the intended cutting line **16** to the line segment **118** corresponds to half the reference distance measure, which is defined by the length of the straight line segment **118**. In other examples, the ratio between the predetermined distance and the reference distance measure of target **214** may be different.

FIG. **4***b* shows a part of a medium **10** after a cutting process along the actual cutting line **24** (shown in FIG. **4***a*). From the part shown in FIG. **4***b*, it can be recognized that the distance from the line segment **118** to the cutting edge **26**, which corresponds to the actual cutting line **24**, in this example is about a quarter of the length of the line segment **118**, which defines to the reference distance measure of target **214**. Because, in the example of FIG. **4**, the predetermined distance is half the reference distance measure, the inspection of the part shown in FIG. **4***b* allows to determine that the cutting error is about a quarter of the reference distance measure.

This inspection may be performed by any suitable person or tool using optical inspection. Accordingly, the cutting accuracy can be assessed qualitatively and quantitatively efficiently. Further, the part can be used as a proof for accuracy. Depending on the accuracy of the process, the target size can be adjusted accordingly. In some examples, in which the cutting process is highly accurate, magnifying glasses, a microscope or similar devices may be used for the assessment.

Further examples of targets which can be used to assess the cutting accuracy according to aspects of the present disclosure are illustrated in FIGS. **5** and **6**.

The target **314** of FIG. **5** comprises two graphical elements in the shape of two parallel straight line segments **118** of equal length and provides two different reference distance measures, namely a first reference distance measure corresponding to the length of the line segments **118** and a second reference distance measure corresponding to the distance of the line segments **118**. A cutting process, wherein the medium **10** is cut in a direction transverse to a direction of the line segments **118**, as indicated in FIG. **5***a*, can be assessed by comparing the length of the line segments **118**, which remain on a cut part, such as the part shown in FIG. **5***b*, to the second reference distance measure defined by the distance of the line segments **118** on the part. In the example shown in FIG. **5***a*, the intended cutting line **16** is assumed to intersect each of the line segments **118** in the center and the first and the second reference distance measures are equal. That is, the length of each line segment **118** is equal to the

distance between the two line segments **118**. By inspecting the part of FIG. **5***b*, it can be recognized that the distance from each end of each line segment **118** to the cutting edge **26** is about a quarter of the second reference distance measure, i.e. the distance between the two line segments **118'**. This information can be obtained by optically inspecting the part of FIG. **5***b*. Accordingly, in this example, the part shown in FIG. **5***b* may help keep the level of the cutting error at about a quarter of the second reference distance measure.

The first reference distance measure of the target **314** of FIG. **5**, i.e. the length of the line segments **118**, also can be used for the assessment of a cutting process in a direction parallel to the straight line segments **118**, as has been explained with reference to FIG. **4**.

The target **414** shown in FIG. **6** comprises a graphical element including two straight line segments **118** which form a cross. In the example shown in FIG. **6***b*, a reference distance measure of the target **414** is visualized and defined by the distance between the intersection of line segments **118** and the lower or upper end of the vertical line segment **118** or both, wherein the vertical line segment **118** is perpendicular to the intended cutting line **16**. Assuming that the intended cutting line **16** intersects the cross of line segments **118** (as shown in FIG. **6***a*), in this example, the part of medium shown in FIG. **6***b* may help keep the level of the cutting error at about half of the reference distance measure of target **414**.

When using one of the above targets **214**, **314**, and **414**, which comprise straight line segments **118**, for quantitatively assessing a cutting error, the complete reference distance measure should be visualized on the inspected part of the cut medium and should be directly perceivable from this part. This is different when using the target **114** of FIG. **3**, which comprises a circle section, for quantitatively assessing a cutting error. For example, when using the part of cut medium **10** shown in FIG. **3***b*, showing less than half a circle, the reference distance measure, i.e. the radius of the circle **18**, is not completely visualized on the part of FIG. **3***b* and is not directly perceivable from the circle section. However, because of the specific symmetry of a circle, depending on the size of the circle section, relative to a full circle, it is possible to determine the distance between the cutting edge **26** and the circle center in terms of the radius, which corresponds to the reference distance measure. The part of cut medium of FIG. **3***b*, for example, comprises a circle section which is less than half a circle and, more specifically, corresponds to a circle portion which allows for the assessment that the distance between the cutting edge **26** and the circle center is about two third of the radius. Accordingly, a quantitative assessment can be possible, even though the reference distance measure (i.e. radius) may not be directly or fully visualized on the part of medium. For the example of a circle, the reference distance measure can be visualized and defined by the curvature of the circle.

Referring to FIG. **7**, a target **514** is illustrated which also allows for a quantitative assessment of the cutting accuracy without a direct perception of the length of a reference distance measure on the part of cut medium which is used for the assessment. The target **514** comprises four concentric circles **18** which may have a radius of 0.5 mm, 1 mm, 1.5 mm and 2 mm, respectively. In other examples, the radii may have any other values. In the example of FIG. **7**, the printed target **514** is centered with respect to two intended cutting lines **16**, which intersect in the center of the target **514**. FIGS. **7***b* and **7***c* show two parts of cut medium which are selected from the parts which are obtained when cutting the medium **10**, shown in FIG. **7***a*, along two perpendicular actual cutting lines **24**. In this example, each cut along one of the actual cutting lines **24** has an error with respect to a corresponding parallel intended cutting line **16**. The parts of FIGS. **7***b* and **7***c* correspond to the portion at the bottom left and the portion at the bottom right, respectively, which are defined by the intersection of the actual cutting lines **24** in FIG. **7***a*. Because each of the rings **18** defines a corresponding reference distance measure and because at least some rings can be determined on the cut part, e.g. by counting the number of rings of a respective part a quantitative assessment can be performed. The number of rings can be counted starting with the outer ring or starting with the inner ring. From the part of FIG. **7***b*, for example, it can be derived that the vertical cutting edge **26** intersects the second inner circle **18** having a radius of 1 mm but not the inner circle having a radius of 0.5 mm. Accordingly, the cutting error of the vertical cut **24** is between 0.5 mm and 1 mm. In a similar way, the part of FIG. **7***c* allows for an analogue assessment, deriving the same error for the vertical cut and an error of 1 mm for the horizontal cut, because the horizontal cutting edge **26** of FIG. **7***c* is a tangent of the second inner circle **18** of radius 1 mm.

In order to make sure that the cutting edges **26** of the part of cut medium are attributed to the correct cutting direction, e.g. vertical and horizontal, and/or that the part of cut medium is attributed to the correct position on the medium, e.g. left, right, above, below of an intended cutting line, the target may comprise a mark **22**, as shown in FIG. **2**. The mark **22** indicates the relative orientation of the target or a portion thereof with respect to the medium and/or the intended cutting lines.

For example, the horizontal line **20** of FIG. **2** may define an intended cutting line **16** and the medium **10** may be cut with a cutting error with respect to this intended cutting line **16** along an actual cutting line **24**. Due to the cutting error, the cutting edge **26** may be above the horizontal line **20** of FIG. **2** or below this line **20**, such that—with respect to the horizontal line **20** in FIG. **2**—an upper part of medium **10** will comprise the mark **22** and a lower part of medium **10** will not have any part of the mark **22** thereon. Accordingly, after the cutting process, both parts can be distinguished and identified as "upper" part comprising the mark **22** and "lower" part not comprising the mark **22**. If, for example, after the cutting process the part of the medium which includes the mark **22** comprises less/more than half of the target, it can be recognized that the actual cutting line **24** is shifted upwards/downwards with respect to the intended cutting line **16**. If, on the other hand, after the cutting process, the part without the mark **22** comprises less/more than half of the target **14**, it can be recognized that the actual cutting line **24** is shifted downwards/upwards with respect to the intended cutting line **16**. Accordingly, based on the location of the mark **22**, the direction of the cutting error can be determined with respect to the corresponding intended cutting line **16**. If the intended cutting line **16** has a defined path relative to the medium **10**, also the direction of the cutting error with respect to the medium **10** may be determined.

FIG. **8** illustrates another example of a target **614** comprising seven concentric rings **18** having radii of 0.5 mm, 1 mm, 1.5 mm, 2 mm, 2.5 mm, 3 mm and 4 mm, respectively. The rings having the radii of 0.5 mm, 1.5 mm and 2.5 mm are printed using a brighter color than the other rings which enhances the readability when assessing the cutting accuracy.

When the lines are printed with different colorants, the graphical elements of a target may appear blurred or fuzzy

due to a color miss-registration. In case of a color miss-registration the dispensing of different colorants may not be aligned. Therefore the visibility can be enhanced when the rings are printed by using just one colorant. Printers usually have the colorants cyan (C), magenta (M), yellow (Y) and black (K), such that just one of these colorants can be used. However, yellow is sometimes difficult to see on a bright medium and black may be mixed with other colorants (composite black), such that it might be challenging to control that only black ink is laid down during printing and such that the lines may appear soft. Therefore, one may chose cyan or magenta as colorant for printing the target for obtaining clear and visible targets.

For printing the target with only one colorant and for printing at the same time different graphical elements of the target with a different brightness it is possible to use for each brightness a corresponding spot color, i.e. a color which is premixed rather than being mixed during printing, wherein the spot colors contain the same colorant but in a different amount. Because a spot color is not created by mixing different colorants during the printing process, color management during printing and colorant contamination can be avoided. For example, if a target is printed with cyan, a spot color of 100% cyan (dark cyan) and another spot color with 70% cyan (lighter cyan) can be used to print darker rings and lighter rings or other graphical elements, respectively. This can ensure that targets can be printed clear and sharp and are better readable.

Referring to FIG. **9**, an example of a process for determining a cutting error is illustrated. In a first stage, a target, such as one of the targets of FIGS. **1** to **7**, is printed on a medium **10**. In a following stage **30**, at least one intended cutting line **16** is defined. In some examples, the path of the intended cutting line **16** is defined with respect to the position and the orientation of the target. In other examples, the path of the intended cutting line **16** is defined with respect to the medium **10**. In the example of FIG. **9**, defining an intended cutting line **16** is performed after printing a target. In other examples, defining can be performed before printing.

Next, as shown in FIG. **9**, the medium can be cut **32** along an actual cutting line **24**, wherein the path of the actual cutting line **24** may deviate from the path of the intended cutting line **16**. The deviation corresponds to a cutting error. Then, as shown in FIG. **9**, a portion of the cut medium may be optically inspected **34**. This inspection may be performed visually by a person without using a measurement tool. In other examples, the inspection may be performed by an inspection device, for example by use of a scanning process. In a later stage, it can be assessed **36**, whether there is a cutting error. The assessment may be qualitative and quantitative or may be quantitative, as explained with regard to FIGS. **1** to **7**.

The target hence can be used for optically assessing the accuracy of cutting a medium along an intended cutting line, when the target is printed on the medium and comprises at least one graphical element which defines at least one reference distance measure. For example, the target can be centered at the intended cutting line or can be positioned at a defined distance from the intended cutting line.

LIST OF REFERENCE SIGNS

10 media sheet
12 graphical object
14, **114**, **214**, **314**, **414**, **514**, **614** target
16 intended cutting line
18, **118** graphical element
20 line
22 mark
24 actual cutting line
26 cutting edge
28, **30**, **32**, **34**, **36** process stages

The invention claimed is:

1. A method comprising:
defining at least one intended cutting line on a medium,
defining a target,
controlling a print engine to print the target on the medium, and
wherein the target comprises at least one graphical element which defines at least one reference distance measure and wherein the target is centered at the intended cutting line or is positioned at a defined distance from the intended cutting line.

2. The method of claim **1**, wherein the graphical element comprises at least one of a curved line segment, a ring line, a circle line, a cross of line segments, a polygon, plural separated line segments and a straight line segment.

3. The method of claim **1**, further comprising
cutting the medium along at least one actual cutting line, the cutting line extending through the at least one graphical element of the target or at a distance to the target less than three times a diameter of the target, and
determining an amount of a deviation of the actual cutting line from the intended cutting line by optically inspecting at least a part of the target on the cut medium relative to the actual cutting line.

4. The method of claim **1**, comprising defining a first intended cutting line and a second intended cutting line, which first and second intended cutting lines are not parallel to each other, wherein relative to each of both of the first and second intended cutting lines the target is centered or is positioned at a defined distance.

5. The method of claim **1**, wherein the at least one graphical element of the target comprises a ring, which is intersected by the at least one intended cutting line, wherein a radius of the ring corresponds to a reference distance measure.

6. The method of claim **1**, wherein the target comprises a number of concentric rings having different radii.

7. The method of claim **6**, wherein at least two intended cutting lines not being parallel and intersecting the center of the rings are defined.

8. The method of claim **6**, wherein the rings have radii in a range between 0.5 mm and 4 mm.

9. The method of claim **1**, wherein the at least one graphical element is printed using only one colorant.

10. The method of claim **1**, wherein the target comprises a number of graphical elements which are printed using at least two different spot colors each containing a different amount of a same colorant.

11. The method of claim **10**, wherein the target comprises a number of graphical elements and at least two different graphical elements are printed at different brightnesses.

12. The method of claim **1**, wherein the target further comprises a mark indicative of the relative orientation of the target on the medium.

13. The method of claim **1**, wherein the target further comprises at least on indication of a value of the at least one reference distance measure.

14. A method of optically assessing the accuracy of cutting a medium along an intended cutting line, wherein a target is printed on the medium and wherein the target comprises at least one graphical element which defines at

least one reference distance measure and wherein the target is centered at the intended cutting line or is positioned at a defined distance from the intended cutting line.

15. A non-transitory machine readable medium, stored thereon machine-readable instructions, which, when executed, cause a system to:

print a target on a medium according to target information, and

cut the medium according to cutting information, wherein the cutting information defines an intended cutting line, along which the medium is intended to be cut, and wherein

the target comprises at least one graphical element which defines at least one reference distance measure and

is centered at the intended cutting line or is positioned at a defined distance from the intended cutting line.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 10,052,890 B2
APPLICATION NO. : 15/547738
DATED : August 21, 2018
INVENTOR(S) : Joan Solans et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Drawings

In sheet 7 of 7, Fig. 9, reference numeral 36, Line 2, delete “und” and insert -- and --, therefor.

Signed and Sealed this
Ninth Day of April, 2019

Andrei Iancu
Director of the United States Patent and Trademark Office